Hindcasting Ecosystems: Exploring Links Between Astrobiology and Earth Science

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We consider South America as a metaphor for the biosphere of a planet that is cooling and drying. Guayaquil is one of the 30 sites we being monitored for connections between remote sensing data of vegetation, climate variables and climate forcings. This paper shows our reference model for hindcasting ecosystems that uses established logic from the literature. That model is

$$\textbf{\textit{Paleo-NPP= [t\_T (\_ NDVI) \_] V.O.S}} \qquad (1)$$

where ***Paleo-NPP*** = net primary productivity in the past, ***t_T*** = NDVI truncated temperature over the growing season, ***_ NDVI*** = NDVI integrated over the growing season, NDVI = normalized difference vegetation index, ***_*** = energy conversion efficiency, ***V.O.S.*** = volcanic, orbital, solar. To hindcast NPP we introduced the volcanic, orbital and solar forcings of Holocene climate according to Bradley in 2003. To parameterize the model we use the NASA-CASA model outputs that are obtained by a separate process. Since the variables of our reference model are not available for hindcasting, we explored available data and calibrated a neural network algorithm in order to predict the NASA-CASA data for NPP in Guayaquil. Our predictions are generated by the model:

$$\textbf{\textit{NPP = f (NDVI, Precip, SolIrr, Atl-SST, Pac-SST)}} \qquad (2)$$

where ***Precip*** = precipitation, ***SolIrr*** = solar irradiance, ***Atl-SST*** =Atlantic sea surface temperature, and ***Pac-SST*** = Pacific sea surface temperature. For hindcasting, the result from (2) are corrected by the V.O.S. terms in (1). Our results show that temperature, not only precipitation, plays an important role in "El Niño" effects on vegetation.